

PROCEEDINGS
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THE UNIQUE, CAVE-RESTRICTED GENUS
APHRASTOCHTHONIUS (PSEUDOSCORPIONIDA,
CHTHONIIDAE)

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Through the efforts of a number of speleologists and the special kindness of Stewart B. Peck and James R. Reddell, I have received for study numerous pseudoscorpions from caves in various parts of America. Among these were four specimens belonging to the genus *Aphrastochthonius* Chamberlin, which had been known previously from only three specimens, all from Alabama (see Chamberlin, 1962, and Muchmore, 1968). Study of these few, new specimens has revealed many more interesting features of the genus and makes possible the description of three new species, from Mexico and Guatemala. This work was supported in part by a research grant (GB 17964) from the National Science Foundation.

Types of the new species are deposited in the American Museum of Natural History.

Genus *Aphrastochthonius* Chamberlin

Aphrastochthonius Chamberlin, 1962, p. 307.

Diagnosis (emended): Based on examination of all known specimens of *Aphrastochthonius*, the characteristics of the genus now appear to be as follows (cf. Chamberlin, p. 307-308).

Carapace of typical chthoniid facies but completely lacking eyes; constricted behind; with vestiture of 16 or 18 macrosetae plus 2-6 lateral microsetae; epistomal process reduced or wanting. Abdomen of usual ovate proportions; pleural membranes finely papillate; tergites and sternites of usual structure; tergal chaetotaxy 4:4:4-4-6:6:6:6:6:2

or 4:T2T:0; genital area of male as illustrated by Chamberlin (p. 309, Fig. 2 H,I); anterior genital operculum of female with 5-7 setae. Coxal area grossly typical; apex of maxilla with 2 setae, the medial one long and heavy, the lateral one short, thin, and turned medially so as to lie against the maxilla dorsal to the other seta (Fig. 1); dorsolateral surface of maxilla with 2-7 microsetae in a linear series extending posteriorly from level of trochanteral fossa; apex of coxa I produced into well-developed process (U.S. species) or rounded lobe (Mexican and Costa Rican species) with 1 to 3 microsetae on the medial side; coxal spines on coxae I and II, comprising in each case a transverse, continuous series of short, bipinnate (U.S.) or parallel-rayed (Mexico and Costa Rica) blades; small, bisetose, intercoxal tubercle present. Chelicera typical; galea vestigial or absent; 5 or 6 setae on palm. Palp very attenuated; chela homodontate, with prominent spaced teeth on each finger and with 1 small, external accessory tooth on fixed finger at base of terminal tooth; base of movable finger with prominent interior sclerotic process (attachment apodeme); movable finger with what appears to be a bipolar neuron running from terminal tooth back into finger, the swollen (presumed) perikaryon lying between finger tip and trichobothrium *t*; movable finger also with a large sensory pit, served by conspicuous bipolar neuron, on dental margin just proximal of last tooth; trichobothria situated as illustrated by Chamberlin (p. 309, Fig. 2A) and below (Fig. 7). Legs of typical chthonioid facies, but attenuated; metatarsus of fourth leg with tactile seta at about middle of segment. All parts lightly sclerotized and pale in color.

Remarks: The emended diagnosis embodies the correction of three errors in the original diagnosis as well as the addition of several important characters not previously noted. Chamberlin was in error when he stated that the intercoxal tubercle of one of the types ("holotype," p. 308, column 1; "allotype," p. 308, column 2) is monosetose—both, upon reexamination, prove to be bisetose. Somehow Chamberlin overlooked the small lateral seta on the apex of the maxilla—it is present, as described, on both types and on all other specimens of the genus. The reduced size and odd placement of this seta in *Aphrastochthonius* is apparently unique among pseudoscorpions, certainly among the chthonioids. In addition, Chamberlin states (p. 308), "base of fixed finger (fig. 2B) with prominent interior sclerotic process. . . ." This is, of course, a typographical error; as Figure 2B itself shows and as mentioned on page 310 in the description of *A. tenax*, it is the *movable* finger which has the sclerotized basal process.

Neither Chamberlin (1962) nor I (1968) noted four other unusual characteristics of *Aphrastochthonius*, all of them unique, or rare, among pseudoscorpions. The pit at the proximal end of the dental row on the movable chelal finger is apparently a sense organ of some sort. While some other pseudoscorpions have a small pitlike sense organ on the

lateral surface of the movable finger (unpublished observations), the placement and morphology of the organ in *Aphrastochthonius* appear not to be duplicated elsewhere. The structure in the tip of the movable finger is nearly identical to the bipolar neuron attached to the pit organ; it is therefore assumed to be connected to some sensory organ in or near the terminal tooth, though none is visible. When first noticed, this structure was considered to be a vestigial venom duct. While this interpretation is now rejected, it is conceivable that the neuron is secretory in nature (though a parallel for such a situation is unknown to me). A third unusual feature is the presence of a small, external accessory tooth at the base of the terminal tooth of the fixed chelal finger. Such a tooth, which meets the tip of the terminal tooth of the movable finger when the chela is closed, is not known to occur in any other heterosphyronid. The fourth feature is the presence of microsetae on the dorsolateral surface of the maxilla, such setae being unreported and unknown to me elsewhere.

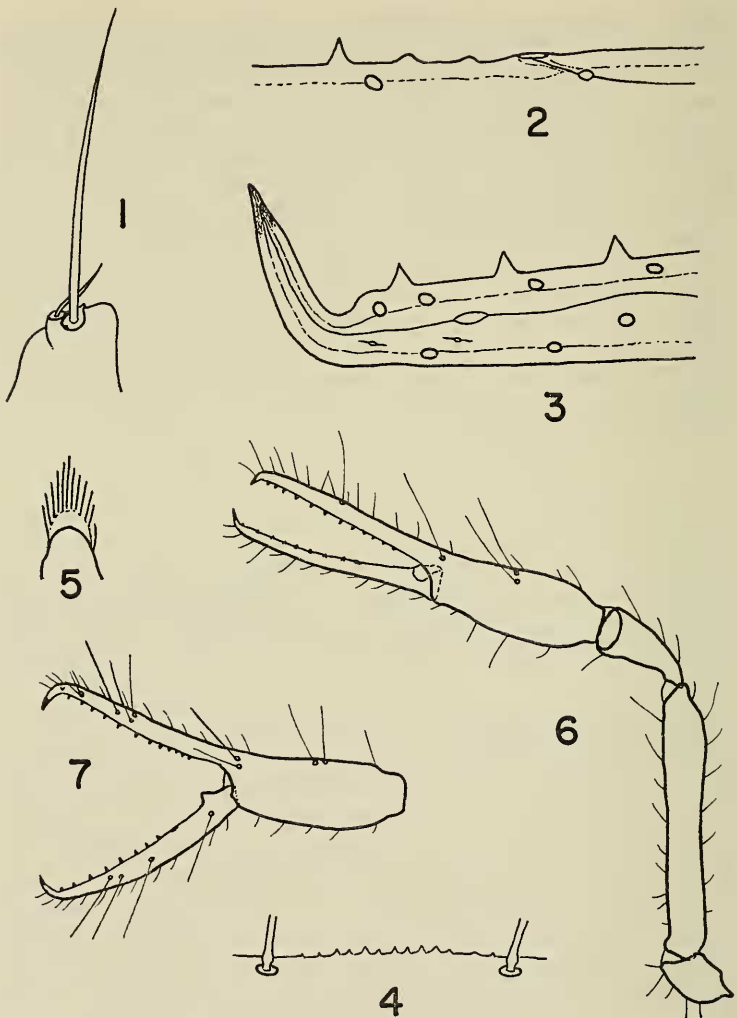
Aphrastochthonius tenax Chamberlin

Aphrastochthonius tenax Chamberlin, 1962, p. 308.

In view of the small number of known individuals of this genus, it is appropriate to report here the discovery of a third specimen of *A. tenax*, a female referable to this species found in Catfish Cave, 0.5 mile S.W. of Bangor, Blount County, Alabama, on 28 June 1967 by S. Peck and A. Fiske. (This location is about 1.5 miles from the type-locality, Bangor Cave.)

In general this specimen is very similar to the allotype female, described by Chamberlin and reexamined by the present author. Both of these show clearly the features mentioned above in correction of Chamberlin's errors, namely the small, recumbent, lateral apical seta on the maxilla (Fig. 1), the bisetose intercoxal tubercle, and the enlarged sclerotic process at the base of the movable chelal finger. Also, they both show clearly the four newly discovered, unique features of *Aphrastochthonius*, namely the sensory pit at the basal end of the dental margin of the movable chelal finger (Fig. 2), the bipolar neuron in the distal end of the movable finger (Fig. 3), the external accessory tooth at the base of the terminal tooth of the fixed chelal finger, and two small setae on the dorsolateral surface of the maxilla.

Two additional features should be noted about the specimen from Catfish Cave, in which it differs from the allotype: the coxal spines number five rather than seven on each coxa I and II, and the cheliceral flagellum consists of 10 or 11, rather than eight or nine, setae. The former certainly represents intraspecific variation, while the latter may be only a result of the great difficulty in seeing clearly the individual setae in a chthoniid flagellum.



FIGS. 1-3. *Aphrastochthonius tenax* Chamberlin. 1. Ventral view of apex of right maxilla. 2. Proximal end of dental edge of movable chelal finger, showing sensory pit just proximal of last denticle. 3. Tip of movable chelal finger, showing presumed bipolar neuron extending into terminal tooth (only sockets of setae represented).

FIGS. 4-7. *Aphrastochthonius parvus* new species, holotype female. 4. Middle section of anterior margin of carapace. 5. Coxal spine from coxa I. 6. Dorsal view of right palp. 7. Lateral view of left chela.

Aphrastochthonius parvus new species

Material: Holotype female (WM 1759.01001) from La Cueva de la Florida, 15 kilometers S.S.W. of Mante, Tamaulipas, Mexico, 10 March 1969 (J. Reddell and S. Fowler). "Found on wall, in left-hand passage."

Description: Female: With the general characteristics of the genus, but distinctly smaller than other known species. Carapace about as long as broad; anterior margin straight, but with 8-10 small denticles at center (Fig. 4); no eyes or eyespots present. Carapace with 16 long, stout setae, and a microseta at each side of anterior margin (m4m-4-4-2-2). Coxal area generally typical; chaetotaxy 1+m-2-1-(2m):3m-3-1-CS:3-2-CS:2-5:2-5; maxilla with 2 microsetae (2m) on the dorsolateral surface; each coxa I with 5 and each coxa II with 7 unique spines, each having a low rounded base and many, long thin parallel rays (Fig. 5); small, bisetose intercoxal tubercle present.

Abdomen typical. Tergal chaetotaxy 4:4:4:5:6:6:6:6:4:T2T:0. Sternal chaetotaxy 7:(3)10(3):(3)11(3):11:11:11:10:11:8:0:2.

Chelicera distinctly shorter than carapace; 2.1 times as long as broad. Palm with 6 setae, *es* very small; fixed finger with 7 teeth, the distal one much the largest; movable finger with about 12 teeth; galea a low bump on margin of movable finger; serrula exterior of about 14 blades; serrula interior of 12 blades; flagellum with about 9 pinnate setae.

Palps typical. Surfaces generally smooth, except flexor surface of femur covered with tiny papillae arranged in longitudinal rows. Proportions of segments shown in Figure 6; trochanter 1.45, femur 6.0, tibia 2.2, and chela 5.4 times as long as broad; hand 2.5 times as long as deep; movable finger 1.22 times as long as hand. Femur 1.55 and chela 2.1 times as long as carapace. Trichobothria of chela as shown in Figure 7. Fixed finger with marginal row of 13 widely spaced, acute teeth and 1 tiny rounded denticle at proximal end of row; also with 1, small accessory tooth on external surface just proximal to base of terminal tooth. Movable finger with 7 spaced, acute teeth, and 1 small rounded, tooth; with a sensory pit in finger margin just proximal to last tooth. Terminal teeth of fixed and movable fingers similar in size and shape, but latter with a bipolar neuron running inward from the tip. Base of movable finger heavily buttressed and with long apodeme for attachment of adductor muscles.

Legs of typical facies. Leg IV with entire femur 2.4 and tibia 5.1 times as long as deep.

Male: Unknown.

Measurements (mm): Body length 1.21. Carapace length 0.31; greatest breadth 0.31. Chelicera 0.265 long by 0.125 broad; movable finger 0.14 long. Palpal trochanter 0.125 by 0.085; femur 0.48 by 0.08; tibia 0.185 by 0.085; chela 0.65 by 0.12; hand 0.30 by 0.12; movable finger 0.365. Leg IV: entire femur 0.385 long; basifemur 0.17 by 0.16;

telofemur 0.265 by 0.155; tibia 0.28 by 0.055; metatarsus 0.135 by 0.045; telotarsus 0.30 by 0.03.

Remarks: This species is easily distinguished from others of the genus by its small size; the palpal femur, for example, being less than 0.5 mm in length. For further discussion, see below.

Etymology: This species is named *parvus* because it is the smallest in the genus.

Aphrastochthonius verapazanus new species

Material: Holotype female (WM 1903.01001) found in La Cueva Sepacuite #2, Senahu Finca Sepacuite, Alta Verapaz, Guatemala, 26 August 1969 (S. and J. Peck).

Description: Female: With the general characteristics of the genus. Carapace a little longer than broad; anterior margin straight, but with about 9 small denticles at middle; no eyes or eyespots present. Carapace with 16 long, stout setae, and a microseta at each side of anterior margin (m4m-2-6-2-2). Coxal area generally typical; chaetotaxy 1+m-2-1-(3m):m-3-1-CS;3-2-CS:-2-5:2-5; maxilla with 3 microsetae (3m) on the dorsolateral surface; each coxa I and each coxa II with 7 spines, similar in structure to those of *A. parvus*; small bisetose intercoxal tubercle present.

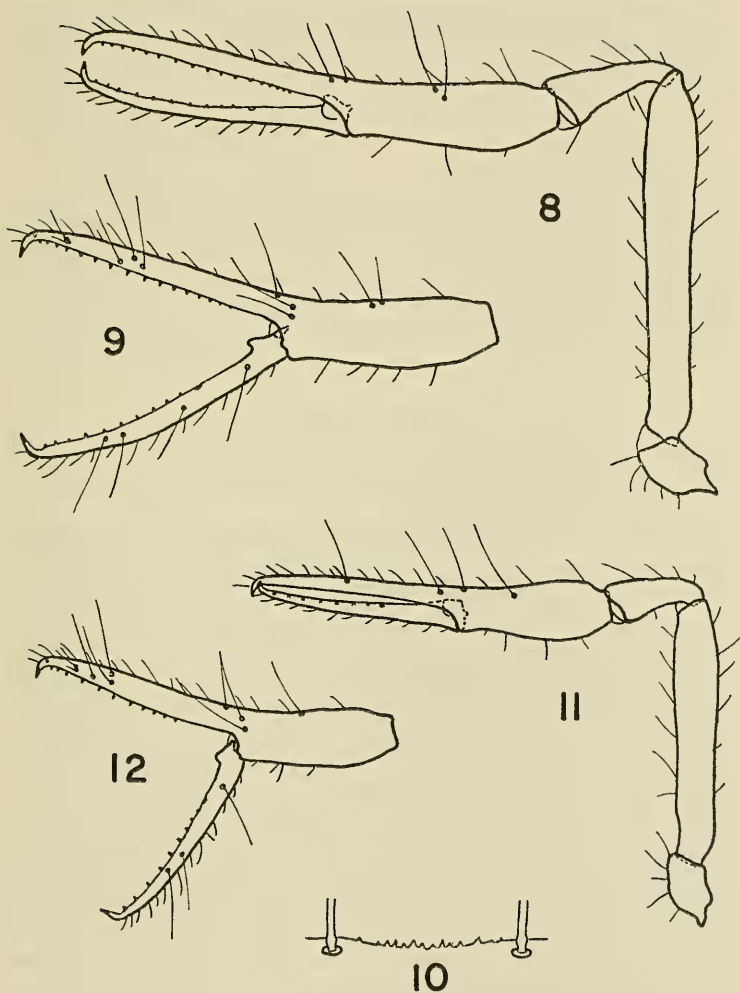
Abdomen typical. Tergal chaetotaxy 4:4:4:4:6:6:6:6:2:T2T:0. Sternal chaetotaxy 5:(3)8(3):(3)11(3):13:12:12:10:P:P:0:2.

Chelicera shorter than carapace; 2.2 times as long as broad. Palm with 6 setae, *es* very small; fixed finger with 8 teeth, the distal ones largest; movable finger with about 10 teeth; galea a very small elevation of finger margin; serrula exterior of 15 blades and serrula interior of 12 blades; flagellum with 8 pinnate setae.

Palps typical. Surfaces, except fingers, covered with tiny papillae, those on flexor surface of femur arranged in longitudinal rows. Proportions of segments shown in Figure 8; trochanter 1.7, femur 7.7, tibia 2.9, and chela 6.7 times as long as broad; hand 3.1 times as long as deep; movable finger 1.27 times as long as hand. Femur 1.91 and chela 2.4 times as long as carapace. Trichobothria of chela as shown in Figure 9. Fixed finger with marginal row of 16 widely spaced, acute teeth, and with small external accessory tooth just proximal to base of terminal tooth. Movable finger with 10 spaced, acute teeth and 1, tiny, rounded denticle at proximal end of row; also with sensory pit in finger margin just proximal to the small denticle. Terminal teeth of fixed and movable fingers similar in size and shape, but latter with delicate neuron running inward from tip. Base of movable finger heavily buttressed and with long apodeme for attachment of adductor muscles.

Legs typical. Leg IV with entire femur 3.7 and tibia 6.7 times as long as deep.

Male: Unknown.



FIGS. 8 and 9. *Aphrastochthonius verapazanus* new species, holotype female. 8. Dorsal view of right palp. 9. Lateral view of left chela.

FIGS. 10-12. *Aphrastochthonius russelli* new species, holotype tritonymph. 10. Middle section of anterior margin of carapace. 11. Dorsal view of right palp. 12. Lateral view of left chela.

Measurements (mm): Body length 1.34. Carapace length 0.35; greatest breadth 0.31. Chelicera 0.31 long by 0.14 broad; movable finger 0.17 long. Palpal trochanter 0.15 by 0.09; femur 0.67 by 0.085; tibia 0.26 by 0.09; chela 0.84 by 0.125; hand 0.385 by 0.125; movable finger 0.49 long. Leg IV: entire femur 0.575 long; basifemur 0.205 by 0.155; telofemur 0.40 by 0.14; tibia 0.40 by 0.06; metatarsus 0.18 by 0.05; telotarsus 0.50 by 0.035.

Remarks: This species is easily separated from *A. parvus* by its larger size and more attenuated appendages. Both these species differ from the Tennessee forms, *A. tenax* and *A. pecki*, in their smaller size, the characteristic rayed structure of the coxal spines, and the presence of only two setae at the posterior margin of the carapace.

Etymology: This species is named for the area in which it was found, Alta Verapaz, Guatemala.

***Aphrastochthonius russelli* new species**

Material: Holotype tritonymph (WM 1752.01001) from La Cueva Pinta, about 12 kilometers N.E. of Valles, San Luis Potosi, Mexico, 31 January 1969 (W. Russell).

Description: Tritonymph: With the characteristics of the genus. Carapace about as long as broad; anterior edge slightly emarginate and with about 12 small denticles at the middle (Fig. 10); no eyes or eyespots present. Carapace with 16 long, stout setae and with 3 microsetae on each side (m4m-m2m-m6m-2-2). Coxal area typical; chaetotaxy 1+m-2-1-(7m):2m-2-1-CS:3-1-CS:1-4:1-4; maxilla with 7 microsetae (7m) in an irregular longitudinal row on the dorsolateral surface; each coxa I with 5 and each coxa II with 6 spines similar in structure to those of *A. parvus*; small, bisetose intercoxal tubercle present.

Abdomen typical. Tergal chaetotaxy 4:4:4:4:6:6:6:6:4:2:T2T:0. Sternal chaetotaxy 5:(2)6(2):(2)8(2):9:9:9:9:7:0:2.

Chelicera shorter than carapace, 2.1 times as long as broad. Palm with 6 setae, *es* very short; fixed finger with 11 teeth, the largest being the third from the distal end; movable finger with 9 teeth, the third and fourth being largest; galea represented by a barely discernible elevation of finger margin; serrula exterior with 12 and serrula interior with 10 blades; flagellum of 7 pinnate setae.

Palps typical. Surfaces, except fingers, covered with tiny papillae, those on flexor surface of femur arranged in longitudinal rows. Proportions of segments shown in Figure 11; trochanter 1.8, femur 5.65, tibia 2.3 and chela 5.85 times as long as broad; hand 2.7 times as long as deep; movable finger 1.39 times as long as hand. Femur 1.45 and chela 1.95 times as long as carapace. Trichobothria of chela typical (Fig. 12), with *sb* absent from movable finger and *isb* absent from dorsum of hand. Fixed finger with 11 spaced, acute, marginal teeth and a small external accessory tooth near base of terminal tooth. Movable

finger with 8 spaced teeth and a small rounded denticle at proximal end of row; also, with sensory pit just proximal to the denticle. Terminal teeth of the fingers similar in size and shape, but latter with a delicate neuron running inward from the tip. Base of movable finger typically heavily buttressed and with long apodeme.

Legs without unusual features.

Male and female: Unknown.

Measurements (mm): Body length 1.04. Carapace length 0.33, greatest width 0.335. Chelicera 0.27 long by 0.13 broad; movable finger 0.155 long. Palpal trochanter 0.125 by 0.07; femur 0.48 by 0.085; tibia 0.185 by 0.08; chela 0.645 by 0.11; hand 0.28 by 0.105; movable finger 0.39 long. Leg IV: entire femur 0.415 long; basifemur 0.155 by 0.135; telofemur 0.28 by 0.125; tibia 0.26 by 0.06; metatarsus 0.125 by 0.045; telotarsus 0.35 by 0.04.

Remarks: While the author is usually very critical of describing new species on the basis of nymphal specimens, it seems best to do just that in the present instance. The specimen under consideration is from a cave about 65 kilometers from the type-locality of *A. parvus*, and it might be expected to represent the tritonymph of that species. However, its size, the proportions of its appendages, and the number of teeth on the chelal fingers do not allow its inclusion in *A. parvus*.

A number of morphological features of *A. russelli* are remarkable and should be mentioned here, but extended discussion will not be profitable at this point, in the absence of any knowledge of adults of this or of nymphs of other species. Chief among the unusual features is the occurrence of three dwarf setae on each side of the carapace. Inasmuch as all known adults of *Aphrastochthonius* have only a single dwarf seta, near the anterior margin, the question arises and remains unanswered whether this feature is diagnostic of *A. russelli* or is only a characteristic of the tritonymphal stage. The same may be said of the occurrence of seven small setae on the side of the maxilla in this species, while others have only two or three such setae. Other interesting features, the systematic significance of which is not known, are the occurrence of two small setae on the apical margin of coxa I, the emargination of the anterior edge of the carapace, and the virtual absence of a galeal elevation.

Etymology: It is a pleasure to name this species for William Russell, who collected the specimen.

KEY TO THE SPECIES OF *APHRASTOCHTHONIUS* (BASED ON FEMALES)

1. Posterior margin of carapace with four setae; coxal spines elongate and bipinnate (eastern U.S.) 2
- Posterior margin of carapace with two setae; coxal spines short and parallel-rayed (Mexico and Costa Rica) 3
2. Palpal femur greater than 0.75 mm in length, l/w ratio greater than 7.0; cheliceral palm with six setae *A. tenax* Chamberlin

- Palpal femur less than 0.70 mm in length, l/w ratio less than 6.0; cheliceral palm with five setae ----- *A. pecki* Muchmore
3. Carapace with a single microseta on each side, "preocular" in position; maxilla with two or three microsetae dorsolaterally ---- 4
Carapace with three microsetae on each side, one "preocular," the others "postocular," in position; maxilla with seven microsetae dorsolaterally (known only from tritonymph) -----
----- *A. russelli* new species
4. Palpal femur greater than 0.6 mm in length; l/w ratio greater than 7.5 ----- *A. verapazanus* new species
- Palpal femur less than 0.5 mm in length; l/w ratio less than 6.5 ----- *A. parvus* new species

Discussion: It is evident from the distribution of *Aphrastochthonius* species, in Alabama, Tamaulipas, San Luis Potosi, and Guatemala, that these are relicts of a formerly widespread group. It is likely that additional representatives of the genus exist in other American caves; and it is not inconceivable that epigeal forms may be discovered in the mountains of Mexico or Central America, where the chthoniid fauna is still virtually unknown. It seems clear that the special characteristics of the genus were developed before the known species retreated into caves, inasmuch as these characteristics are shared by forms in widely separated and independently developed cave systems. Thus, while the genus as we know it at present is cave restricted, the features such as the presumed sensory neuron in the tip of the movable chelal finger, the sensory pit on the dental margin of the same finger, the accessory tooth on the fixed chelal finger, and the microsetae on the side of the maxilla must have evolved in some widespread epigeal environment which has since disappeared.

As Chamberlin pointed out (1962), the relationship of *Aphrastochthonius* to other heterosphyronid genera is obscure. In the possession of coxal spines on coxae I and II and in the shape and dentition of the chela it resembles some dithids and the chthoniid genus *Pseudochthonius*. It differs from the dithids in the lack of distinct, oblique stigmatic plates and in the possession of a bisetose, intercoxal tubercle, though some members of that group have only very weakly sclerotized and nearly transverse stigmatic plates and a monosetose intercoxal tubercle. From *Pseudochthonius* it differs mainly in the presence of the intercoxal tubercle and in some details of chaetotaxy of the carapace, coxae, and chela. While most species of *Pseudochthonius* have chelal fingers very different from those of *Aphrastochthonius*, *P. orthodactylus* Muchmore (1971) possesses a chela which is very like that of *Aphrastochthonius* in shape and dentition. If it can be assumed that the condition of the chela in *P. orthodactylus* is primitive for *Pseudochthonius*, then a relationship between that genus and *Aphrastochthonius* is more easily conceived. However, separation of the genera must have been of long

duration to have allowed for the many peculiar characteristics of each. Further speculation along these lines will have to await fuller knowledge of all the various heterosphyronid genera.

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